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$$\therefore \text{Distance of focus from center} = \sqrt{\frac{A-B}{m}}.$$

Let θ = the angle the principal axes make with the sides, then if u, v be the coördinates of the focus, we easily get :

$$u = \sqrt{\frac{A-B}{m}} \cos \theta, \quad v = \sqrt{\frac{A-B}{m}} \sin \theta.$$

$$\therefore u^2 + v^2 = \frac{A-B}{m}, \quad u^2 - v^2 = \frac{A-B}{m} \cos 2\theta.$$

From problem 94, solution on page 48, Vol. VII, No. 2, we get

$$u^2 + v^2 = \frac{1}{2} \sqrt{[a^4 + b^4 + 2a^2b^2 \cos 2\beta]}.$$

$$u^2 - v^2 = \frac{1}{2}(a^2 + b^2 \cos 2\beta).$$

Eliminating $\cos 2\beta$ we get

$$144(u^2 + v^2)^2 = 24a^2(u^2 - v^2) - a^4 + b^4.$$

Let $u = r \cos \varphi, v = -r \sin \varphi$.

$$\therefore 144r^4 = 24a^2r^2 \cos 2\varphi - a^4 + b^4, \text{ or } r^4 = \frac{1}{144}a^2r^2 \cos 2\varphi - a^4/144 + b^4/144.$$

If $a = b, r^2 = \frac{1}{144}a^2 \cos 2\varphi$.

104. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pa.

From a locomotive and tender standing still on a bridge, the pressure on the bridge is $p_1 = 80$ tons. The track is supposed to be straight and practically horizontal. Had the locomotive and tender been running at the rate of $r = 60$ miles an hour, how many tons would the pressure on the bridge have been?

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

$$p_1 = 80 \text{ tons} = W = mg.$$

Both m and g are constant.

\therefore The pressure is the same, 80 tons, no matter what the velocity.

DIOPHANTINE ANALYSIS.

83. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Find three numbers in arithmetical progression whose sum is a square and cube.

I. Solution by J. W. YOUNG, Cornell University, Ithica, N. Y.; B. L. REMICK, Bradley Polytechnic Institute, Peoria, Ill.; and ALOIS F. KOVARIK, Decorah Institute, Decorah, Ia.

A number which is a square and a cube is a sixth-power.

Also three numbers in arithmetical progression may be represented by

$$a-d, a, a+d; \text{ whose sum is } 3a.$$

These considerations lead at once to the following expressions for the required numbers : 3^5x^6-d , 3^5x^6 , 3^5x^6+d , where x , d , are any numbers.

The sum is evidently $(3x)^6 = [(3x)^2]^3 = [(3x)^3]^2$.

As an example we may take $x=1$, $d=100$.

$$143, 243, 343, \text{ whose sum} = 729 = 27^2 = 9^3.$$

II. Solution by the PROPOSER.

Let $\frac{1}{3}(x-y)^2$, $\frac{1}{3}(x^2+y^2)$, $\frac{1}{3}(x+y)^2$ be the three numbers.

Their sum is x^2+y^2 .

Let $x^2+y^2=a^6m^6$. Let $x=m^2-n^2$, $y=2mn$.

$$\therefore x^2+y^2=(m^2+n^2)^2=a^6m^6.$$

$$\therefore m^2+n^2=a^3m^3.$$

Let $n=pm$.

$$\therefore m^2(1+p^2)=a^3m^3.$$

$$\therefore m=\frac{1+p^2}{a^3}, n=-\frac{p(1+p^2)}{a^3}.$$

$$x=\frac{(1+p^2)^2(1-p^2)}{a^6}, y=\frac{2p(1+p^2)^2}{a^6}, x^2+y^2=\frac{(1+p^2)^6}{a^{12}}.$$

\therefore The numbers are

$$\frac{1}{3}\left(\frac{(1+p^2)^2(1-2p-p^2)}{a^6}\right)^2, \quad \frac{1}{3}\left(\frac{(1+p^2)^6}{a^{12}}\right), \quad \frac{1}{3}\left(\frac{(1+p^2)^2(1+2p-p^2)}{a^6}\right)^2.$$

Also solved by CHAS. C. CROSS, JOSIAH H. DRUMMOND, M. A. GRUBER, J. SCHEFFER, and ELMER SCHUYLER.

84. Proposed by the late SYLVESTER ROBINS, North Branch Depot, N. J.

The n th term of an infinite series of "nests" contains all the prime, integral, rational parallelopipeds that have 3^n for their solid diagonals. It is required to determine the general expression for N =the number of such solids in n th term, and to exhibit the dimensions of all the "eggs" in the first six nests.

Solution by M. A. GRUBER, A. M., War Department, Washington, D. C.

In parallelopipeds the square of the solid diagonal equals the sum of the squares of the three dimensions (length, breadth, and height). Whence, $(3^n)^2 =$ the sum of three squares.

When $(3^n)^2$ =the sum of three *integral* squares, I have found, by inspection, that the entire number of sets of three squares is, in terms of n , $\frac{3^n+2n-1}{4}$, of which $\frac{3^{n-1}+1}{2}$ are prime sets, and $\frac{3^{n-1}+2n-3}{4}$ multiple sets.

$$\therefore \text{According to the problem, } n=\frac{3^{n-1}+1}{2}.$$

In *prime* sets of the sum of three squares equal to a square, it will be observed that two of the three squares are even and the other odd.

By means of an extensive table containing the odd numbers that are equal